

Section 4

Energy Conservation

Reading Preview

Key Concept

- What are two ways to preserve our current energy sources?

Key Terms

- efficiency
- insulation
- energy conservation

Target Reading Skill

Using Prior Knowledge Before you read, write what you know about energy efficiency and conservation in a graphic organizer like the one below. As you read, write what you learn.

What You Know



- I turn off lights to conserve energy.
-

What You Learned

-
-

Lab zone Discover Activity

Which Bulb Is More Efficient?

- Record the light output (listed in lumens) from the packages of a 60-watt incandescent light bulb and a 15-watt compact fluorescent bulb.
-   Place the fluorescent bulb in a lamp socket. **CAUTION:** Make sure the lamp is unplugged.
- Plug in the lamp and turn it on. Hold the end of a thermometer about 8 centimeters from the bulb.
- Record the temperature after five minutes.
- Turn off and unplug the lamp. When the bulb is cool, remove it. Repeat Steps 2, 3, and 4 with the incandescent light bulb.

Think It Over

Inferring The 60-watt bulb uses four times as much energy as the 15-watt bulb. Does it also provide four times as much light output? If not, how can you account for the difference?



What would happen if the world ran out of fossil fuels today? The heating and cooling systems in most buildings would cease to function. Forests would disappear as people began to burn wood for heating and cooking. Cars, buses, and trains would be stranded wherever they ran out of fuel. About 70 percent of the world's electric power would disappear. Since televisions, computers, and telephones depend on electricity, communication would be greatly reduced. Lights, microwave ovens, and most other home appliances would no longer work.

Although fossil fuels won't run out immediately, they also won't last forever. Most people think that it makes sense to use fuels more wisely now to avoid fuel shortages in the future. **One way to preserve our current energy resources is to increase the efficiency of our energy use. Another way is to conserve energy whenever possible.**

Section 4

Energy Conservation

Objectives

After completing the lesson, students will be able to

E.5.4.1 Name ways to ensure that there will be enough energy for the future.

E.5.4.2 Identify ways individuals can conserve energy.

Target Reading Skill

Using Prior Knowledge Explain that using prior knowledge helps students connect what they already know to what they are about to read.

Answers

Possible answers:

What You Know

- I turn off lights to conserve energy.
- I walk instead of ride in a car when possible.

What You Learned

- One way to preserve our current energy resources is to increase efficiency.
- One method of increasing efficiency of heating and cooling systems is to use insulation.
- Compact fluorescent bulbs use about one fourth as much energy as incandescent light bulbs.

All in One Teaching Resources

- [Transparency E50](#)

Preteach

Build Background Knowledge

L2

Identifying Wasteful Energy Use

Point out the section's title and ask: **What does the term *energy conservation* mean?** (Accept all reasonable responses, such as "not wasting energy.") **What are some examples of wasting energy?** (Possible answers: Setting a heater thermostat too high; leaving lights on in an unoccupied room; running a dishwasher with only a small load)

Lab zone Discover Activity

Skills Focus

Inferring
Materials light bulbs in packages (60-watt incandescent and 15-watt compact fluorescent), lamp, thermometer, clock or watch

Time 20 minutes

Tips Compact fluorescent bulbs, widely available in supermarkets and hardware stores, screw into a regular bulb socket.

L1 Expected Outcome The fluorescent bulb will produce a lower temperature.

Think It Over Light output varies among bulbs. The fluorescent bulb is about 4 times more efficient (825 lumens/15 watt compared to 900 lumens/60 watt). The incandescent bulb is less efficient because it converts so much energy into heat.

Instruct

Energy Efficiency

Teach Key Concepts

L2

Using Fuels Efficiently

Focus Remind students that when we say we are increasing the efficiency of a device that consumes energy, we mean that we are increasing the percentage of consumed energy the device uses to do work and decreasing the percentage of consumed energy that is lost to the surroundings.

Teach Explain to students that energy efficiency can be improved in many areas of our lives. Draw a chart on the board that will show types of energy use and ways to increase efficiency; fill it in as students discuss. Ask: **What are the main categories of energy use that can be affected by changes in energy efficiency?**

(Transportation, heating and cooling, lighting) **What is the most common way to improve efficiency of heating and cooling?**

(Adding fiberglass insulation or a layer of air) **Name ways that energy efficiency can be improved in transportation and lighting.**

(Transportation—better engines and tires, public transportation, carpooling; lighting—using compact fluorescent bulbs)

Apply Ask: **How can you personally improve energy efficiency?** (Take the bus or carpool, check on lighting and heating/ cooling at home) **learning modality: visual**

Independent Practice

L2

All in One Teaching Resources

- [Guided Reading and Study Worksheet: Energy Conservation](#)

Student Edition on Audio CD

Energy Efficiency

One way to make energy resources last longer is to use fuels more efficiently. **Efficiency** is the percentage of energy that is actually used to perform work. The rest of the energy is “lost” to the surroundings, usually as heat. People have developed many ways to increase energy efficiency.

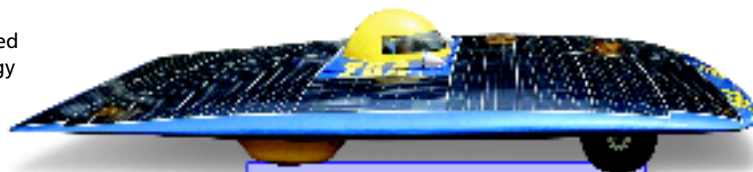
Heating and Cooling One method of increasing the efficiency of heating and cooling systems is insulation. **Insulation** is a layer of material that traps air to help block the transfer of heat between the air inside and outside a building. You have probably seen insulation made of fiberglass, which looks like pink cotton candy. A layer of fiberglass 15 centimeters thick insulates a room as well as a brick wall 2 meters thick!

Trapped air can act as insulation in windows, too. Many windows consist of two panes of glass with space between them. The air between the panes of glass acts as insulation.

Tech & Design in History

Energy-Efficient Products

Scientists and engineers have developed many technologies that improve energy efficiency and reduce energy use.



1958 Solar Cells

More than 150 years ago, scientists discovered that silicon can convert light into electricity. The first useful application of solar cells was to power the radio on a satellite. Now solar cells are even used on experimental cars like the one above.



1932 Fiberglass Insulation

Long strands of glass fibers trap air and keep buildings from losing heat. Less fuel is used for heating.



1936 Fluorescent Lighting

Fluorescent bulbs were introduced to the public at the hundredth anniversary celebration of the United States Patent Office. Because these bulbs use less energy than incandescent bulbs, most offices and schools use fluorescent lights today.

1930

1940

1950

1960

Lighting Much of the electricity used for home lighting is wasted. For example, less than 10 percent of the electricity that an incandescent light bulb uses is converted into light. The rest is given off as heat. In contrast, compact fluorescent bulbs use about one fourth as much energy to provide the same amount of light.

Transportation Engineers have improved the energy efficiency of cars by designing better engines and tires. Another way to save energy is to reduce the number of cars on the road. In many communities, public transit systems provide an alternative to driving. Other cities encourage carpooling. Many cities now set aside lanes for cars containing two or more people.



What are two examples of insulation?

Writing in Science

Research and Write Design an advertisement for one of the energy-saving inventions described in this timeline. The advertisement may be a print, radio, or television ad. Be sure that your advertisement clearly explains the benefits of the invention.

Help Students Read L1

Summarize Summarizing the information presented in the text will help students focus on main ideas and remember what they read. Have students read the paragraphs about energy efficiency and summarize them by restating the main idea in their own words.

Tech & Design in History

Focus Explain to students that new scientific discoveries and the development of new materials has helped produce many new energy-efficient products.

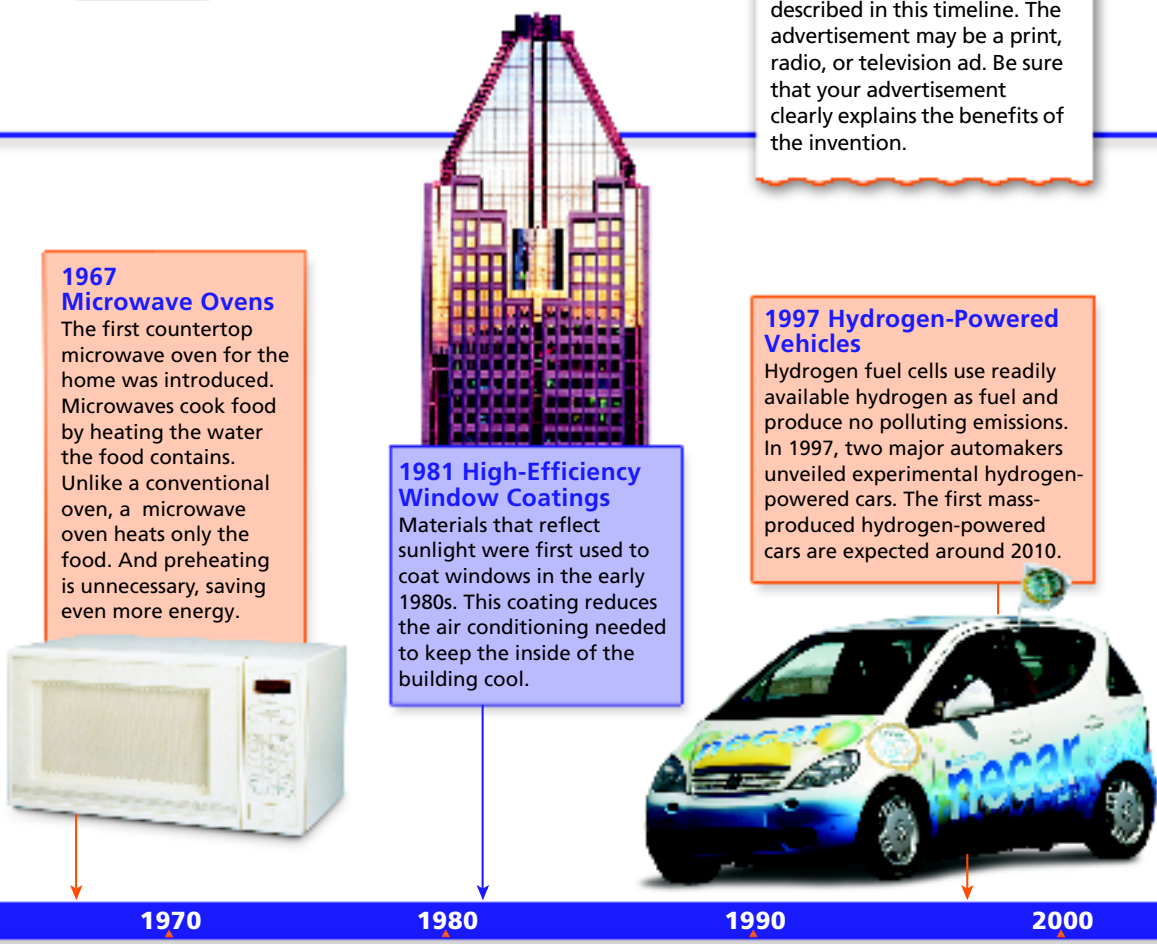
Teach Call on volunteers to read the entries on the time line. Ask students with personal experiences with the technologies to relate them to the class. Ask: **How could hydrogen-powered vehicles affect our lives?** *(Answers will vary. Sample answer: It could reduce environmental pollution and lessen political stress arising from dependence on fossil fuels.)*

Writing in Science

Writing Mode Research

Scoring Rubric

- 4 Includes clear explanations of several benefits; tone convincing
- 3 Includes clear explanations of a few benefits; tone convincing
- 2 Benefits named but explanations unclear; tone unconvincing
- 1 Number and explanation of invention's benefits inadequate



Differentiated Instruction

Special Needs

Identifying Energy Efficiency Pair students having difficulty with those who have a clear concept of energy efficiency. Have each pair of students compile a list

L1 of ways to individually improve energy efficiency on a daily basis. Students can reinforce concepts with *Student Edition on Audio CD*. **learning modality: verbal**

Monitor Progress L2

Drawing Have each student draw and label a diagram to explain how insulation conserves energy. Students can save their drawings in their portfolios.



Answer



Fiberglass, trapped air

Energy Conservation

Teach Key Concepts

Reducing Energy Use

Focus Tell students that the efforts any one person makes to conserve energy make a difference when many people make such an effort.

Teach Ask: **What are some ways to conserve energy?** (*Walk instead of riding in a car, recycle, use fans instead of air conditioners, turn off light and television when leaving a room*)

Apply Ask how many students practice these ideas. Then discuss other suggestions that students might have for conserving energy, such as using natural lighting instead of electric lights whenever possible, keeping the home cooler in winter and warmer in summer, and using public transportation.

learning modality: verbal

Monitor Progress L2



Walking instead of riding in a car; recycle

Assess

Reviewing Key Concepts

1. **a.** increasing energy efficiency and reducing energy use **b.** Insulation reduces the amount of heat lost to the outside in cold weather and helps keep heat outside in warm weather, reducing the amount of fuel needed to heat and cool buildings. Carpooling results in fewer cars on the road and, therefore, a reduction in the amount of gas being used. **c.** The building with incandescent bulbs because they are far less efficient than fluorescent; most of the electrical energy they use is released as heat.

Reteach L1

With students, list ways to improve energy efficiency and promote energy conservation.

Performance Assessment

Oral Presentation Have each student describe one energy-saving idea that he or she will take responsibility for implementing at home. L2

All in One Teaching Resources

- [Section Summary: Energy Conservation](#)
- [Review and Reinforce: Energy Conservation](#)
- [Enrich: Energy Conservation](#)

FIGURE 16

Energy Conservation

There are many ways you can conserve energy.



Energy Conservation

Another approach to making energy resources last longer is conservation. **Energy conservation** means reducing energy use.

You can reduce your personal energy use by changing your behavior in some simple ways. For example, if you walk to the store instead of getting a ride, you are conserving the gasoline it would take to drive to the store. You can also follow some of the suggestions in Figure 16.

While these suggestions seem like small things, multiplied by millions of people they add up to a lot of energy saved for the future.



What are two ways you can reduce your personal energy use?

Section 4 Assessment



Target Reading Skill Using Prior Knowledge Review your graphic organizer and revise it based on what you just learned in the section.

Reviewing Key Concepts

- a. Identifying** What are the two keys to preserving our current energy resources?
- b. Applying Concepts** How does insulating buildings help to preserve energy resources? How does carpooling preserve resources?
- c. Predicting** One office building contains only incandescent lights. The building next door contains only fluorescent lights. Predict which building has higher energy bills. Explain your answer.

Writing in Science

Energy Savings Brochure

Conduct an energy audit of your home. Look for places where energy is being lost, such as cracks around doors. Also look for ways to reduce energy use, such as running the dishwasher only when it is full. Then create a short, illustrated brochure of energy-saving suggestions. Keep the brochure where everyone can see it.

Writing in Science

Writing Mode Cause and Effect Explanation

Scoring Rubric

- 4 Includes four or more suggestions with colorful illustrations; neat and organized
- 3 Includes two or three suggestions with colorful illustrations; neat and organized

- 2 Includes only one suggestion, well organized and illustrated, or more than one with poor illustrations or lack of organization
- 1 Includes only one suggestion, poor illustrations, lack of organization

Keeping Comfortable

Problem

How well do different materials prevent heat transfer?

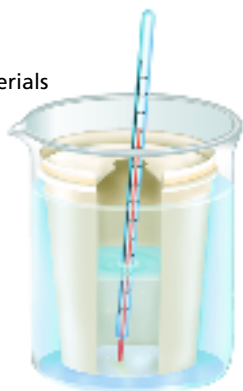
Skills Focus

measuring,
controlling variables

Materials



- watch or clock
- beakers
- ice water
- hot water
- thermometers or temperature probes
- containers and lids made of paper, glass, plastic, plastic foam, and metal



Procedure



1. Use a pencil to poke a hole in the lid of a paper cup. Fill the cup halfway with cold water.
2. Put the lid on the cup. Insert a thermometer into the water through the hole. (If you are using a temperature probe, see your teacher for instructions.) When the temperature stops dropping, place the cup in a beaker. Add hot water to the beaker until the water level is about 1 cm below the lid.
3. Record the water temperature once every minute until it has increased by 5°C. Use the time it takes for the temperature to increase 5°C as a measure of the effectiveness of the paper cup in preventing heat transfer.
4. Choose three other containers and their matching lids to test. Design an experiment to compare how well those materials prevent heat transfer. You can use a similar procedure to the one you used in Steps 1–3.

Analyze and Conclude

1. **Measuring** In Step 2, what was the starting temperature of the cold water? How long did it take for the temperature to increase by 5°C? In which direction did the heat flow? Explain.
2. **Making Models** If the materials in Steps 1–3 represented your home in very hot weather, which material would represent the rooms in your home? The outdoor weather? The building walls?
3. **Controlling Variables** In the experiment you conducted in Step 4, what were the manipulated and responding variables? What variables were kept constant?
4. **Drawing Conclusions** Which material was most effective at preventing the transfer of heat? Which was the least effective? Explain how your data support your conclusion.
5. **Communicating** Write a paragraph explaining why the results of your experiment could be useful to people building energy-efficient structures.

Design an Experiment

Design an experiment to compare how well the materials you tested would work if the hot water were inside the cup and the cold water were outside. *Obtain your teacher's permission before carrying out your investigation.*

Go online
PHSchool.com

For: Data sharing
Visit: PHSchool.com
Web Code: ced-5054

Expected Outcome

Plastic foam is most effective for stopping heat transfer; metal is least effective.

Analyze and Conclude

1. Temperatures and times will vary. Heat flowed from the hot water to the cold water, as shown by the temperature changes.
2. *Rooms:* cold water; *outdoor weather:* hot water; *walls:* paper cup.
3. *Manipulated:* container material;
responding: water temperature in cup;

constant: initial temperature of water in beaker.

4. *Most effective:* plastic foam; *least effective:* metal. Cold water stayed close to its starting temperature for the longest time with plastic foam; temperature increased the fastest with metal.
5. Paragraph should discuss choices of building materials in terms of conserving energy used for heating and cooling.

Keeping Comfortable 12

Prepare for Inquiry

Skills Objectives

After this lab, students will be able to

- measure temperature changes of water in a paper cup for use as a baseline
- control variables to compare how different materials slow heat transfer



Prep Time 20 minutes

Class Time 40 minutes

Advance Planning

Prepare hot and ice water ahead of time and keep them in insulated containers. **CAUTION:** *Do not use water hot enough to cause scalding.*



If using probeware, refer to the **Probeware Lab Manual**.

Safety



Students should use caution in handling the thermometers, hot water, and glass

containers. Review the safety guidelines in Appendix A.

All in One Teaching Resources

- Lab Worksheet: *Keeping Comfortable*

Guide Inquiry

Invitation

Ask: **What experiences have you had with different materials stopping heat transfer?** (*Answers could include using a potholder versus a dishtowel, stirring hot liquid with a metal or plastic spoon, and so on.*)

Troubleshooting the Experiment

- Make sure students control all variables and record temperatures at regular intervals.

Extend Inquiry

Design an Experiment Students' plans should follow an approach similar to that of Steps 1–4.

Go online
PHSchool.com

For: Data sharing
Visit: PHSchool.com
Web Code: ced-5054

Students can share data online.

Technology and Society

The Hybrid Car

Key Concept

Hybrid cars can use both a gasoline engine and an electric motor to turn the transmission.

Build Background Knowledge

Recalling Effects of Fossil Fuel Use

Help students recall what they learned in this chapter that applies to the feature content.

Ask: **What is a fossil fuel?** (*Energy-rich substance formed from the remains of organisms*) **What type of fossil fuel is used by most automobiles?** (*Gasoline*) **What are the problems associated with the use of fossil fuels?** (*Environmental pollution, limited supply*)

Introduce the Debate

Ask: **What are the main problems associated with the current way cars are fueled?** (*Possible answers: Gasoline contributes to air pollution; it is a limited resource; gasoline prices continue to rise.*)

What are some ways that individuals and governments have tried to solve some of the problems? (*Students might suggest state and federal laws regarding emissions standards and fuel economy.*)

Facilitate the Debate

- Have students suppose that they are members of a consumer group studying the value of hybrid cars. Students can role-play different members of the group who have varying opinions about the value of hybrid cars.
- Students can find out if and how the body design of the hybrid cars differs from that of conventional cars, the problems associated with hybrid cars, and current research going on to improve them. Students should also consider where they can be bought, what to look for when buying one, and how their price compares with that of conventional cars.
- After the debate, students can write a consumer's report for a car magazine.

Technology and Society

Tech & Design

The Hybrid Car

How do you get from here to there? Like most people, you probably rely on cars or buses. Engines that burn fossil fuels power most of these vehicles. To conserve fossil fuels, as well as to reduce air pollution, some car companies have begun to produce hybrid vehicles.

How Are Hybrid Cars Different?

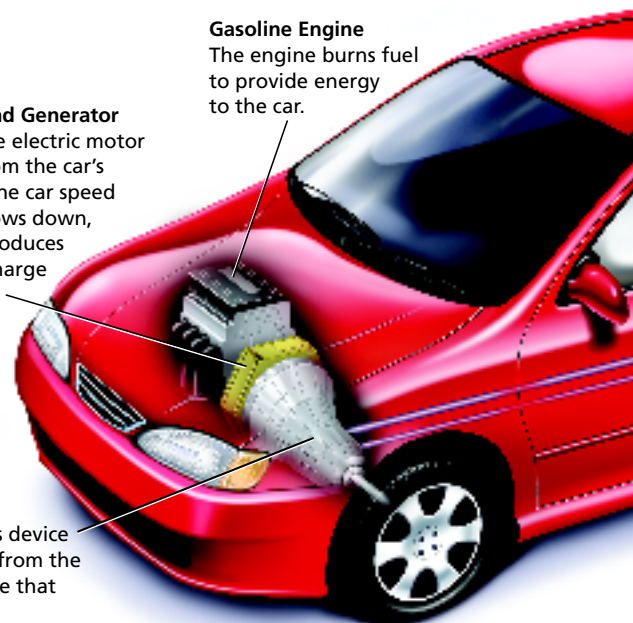
The power source for most cars is a gasoline engine that powers the transmission. Unlike conventional cars, hybrid cars can use both a gasoline engine and an electric motor to turn the transmission. The generated power can be used by the transmission to turn the wheels. Or power can be converted into electricity for later use by the electric motor. Any extra electricity is stored in the car's battery. The gasoline engine in a hybrid car is smaller, more efficient, and less polluting than the engine in a conventional car.

Electric Motor and Generator

In this model, the electric motor draws energy from the car's battery to help the car speed up. As the car slows down, the generator produces electricity to recharge the car's battery.

Gasoline Engine
The engine burns fuel to provide energy to the car.

Transmission This device transmits power from the engine to the axle that turns the wheels.



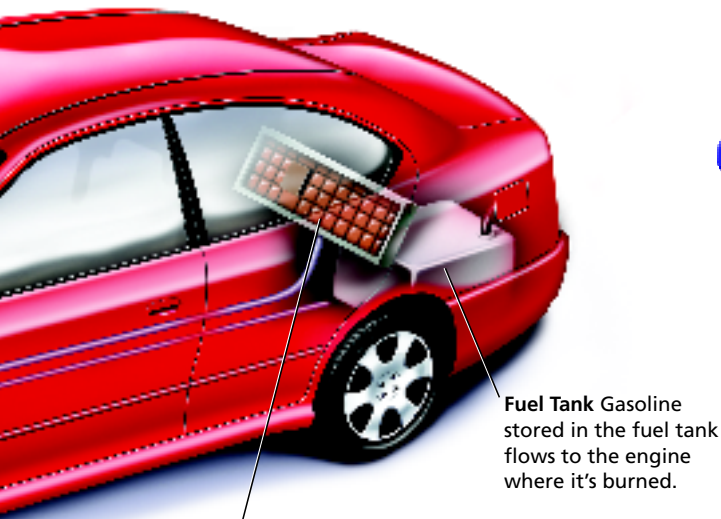
Start
The car uses power from its battery to start the gasoline engine.

Accelerate
When the car accelerates, the electric motor and the gasoline engine work together to power the car.

Brake
When the car brakes, the motor acts like a generator and stores electrical energy in the battery.

Are Hybrid Cars the Way to Go?

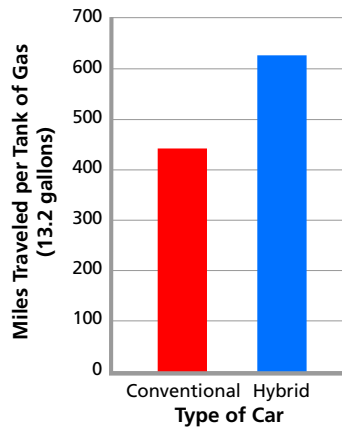
Hybrid cars consume less gas per mile and emit fewer pollutants than cars that run on gasoline alone. In spite of the benefits, there are some drawbacks to hybrid cars. In general, hybrid cars have less power for climbing steep hills and less acceleration than cars with larger engines. In addition, the large batteries could be an environmental hazard if they end up in a landfill. Drivers must make trade-offs in buying any car.



Battery The car's electric motor uses energy stored in the battery.

Stop
When the car stops or idles, the gasoline engine stops. It restarts when the driver steps on the gas pedal.

Mileage per Tank of Gas



Weigh the Impact

1. Identify the Need

Why are some car companies developing hybrid cars?

2. Research

Research hybrid cars currently on the market. Use your findings to list the advantages and disadvantages of hybrid-car technology.

3. Write

Should your family's next car be a conventional or hybrid model? Use the information here and your research findings to write several paragraphs supporting your opinion.

Go Online
PHSchool.com

For: More on hybrid cars
Visit: PHSchool.com
Web Code: ceh-5050

Weigh the Impact

1. Students might cite new federal and state regulations regarding emission standards and fuel economy.
2. Information might include advantages such as fuel economy and environmental friendliness; disadvantages might include more complicated production process and reduced trunk capacity in some models.
3. Encourage students to consider all the information they have collected before they write their opinions. Remind them to support their opinions with facts.

Go Online
PHSchool.com

For: More on hybrid cars
Visit: PHSchool.com
Web Code: ceh-5050

Students can research this issue online.

Extend

Encourage students to search the Internet for diagrams of hybrid cars. Students can include a diagram in their written opinions to support their information.